DENALI NATIONAL PARK AND PRESERVE

CENTRAL ALASKA NETWORK

Vegetation Monitoring Program

Summary Trip Report: Lower Muldrow Glacier Mini-grid

27 July – 3 August, 2009

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September, 2009

PURPOSE:

The purpose of this trip was to establish and measure 25 permanent plots located in the Lower Muldrow Glacier mini-grid according to the Central Alaska Network (CAKN) vegetation monitoring protocols (see Roland *et al*. 2005). We successfully sampled the complete mini grid with the exception of one point which landed in the middle of the Thorofare River and was thus not possible to sample.

PERSONNEL:

Carl Roland – crew leader, navigation, vascular plant composition/collection, plot/quadrat variable estimates, transect data
Peter Nelson –navigation, non-vascular plant composition/collection, soils
Carmen Backes – plot photos, sapling measurements, transect data
Jamie Martin – vascular plant composition/collection, plot/quadrat variable estimates, transect data, plot photos

ACCESS TO MINI-GRID AND CAMPING POSSIBILITIES:

The Park Road passes through the Lower Muldrow Glacier Mini Grid making vehicle travel the best option to access the study area. Park rules prohibit any camping within view of the road, so it is necessary to pack gear and equipment to a location concealed by topography. Near the road, the landscape is broad and treeless, giving wide sweeping views over great distances (Map 1). The best option for a hidden campsite is near the Thorofare River (Map 2).

In advance of our trip, we obtained permission to utilize the Thorofare River Patrol Cabin. It is located at (-150.4458 W x 63.4214 N), placing it within the mini-grid. To get there, we drove to a gravel pit near mile 70 of the Park Road. We hiked along a path from the gravel pit to the cabin, a distance of about 1 km. We kept our equipment, food, and cooking items in the cabin, and pitched our tents in the valley below. There is a bunk bed in the cabin, and Carl slept there during his stay. We had access to an outhouse, as well as a shelter from serious weather and wild animals—luxuries not often had in this line of work. We also had access to a small stream with fresh water in the valley below the cabin. This was an asset because it meant we did not need to carry in water from the road or try to use the chocolate milk/high sediment glacial water of the Thorofare.

Not knowing in advance what the cabin would be like, or what the hike to the cabin would be like, we brought along helpers to help transport gear and equipment into the cabin. Mid way through the plot, we were revisited by the helpers, as well as having a "changing of the guard" with Carl leaving the team and Carmen joining. This gave us opportunities for shuttling items back and forth between the road and camp without using much extra work time. Also, we were creative about ways to reduce the weight for any given trip. For example, we packed light and initially only brought two bear barrels each. Then, when the

helpers came during the middle of our stay, they brought in the extra barrel and carried out a garbage-filled one.

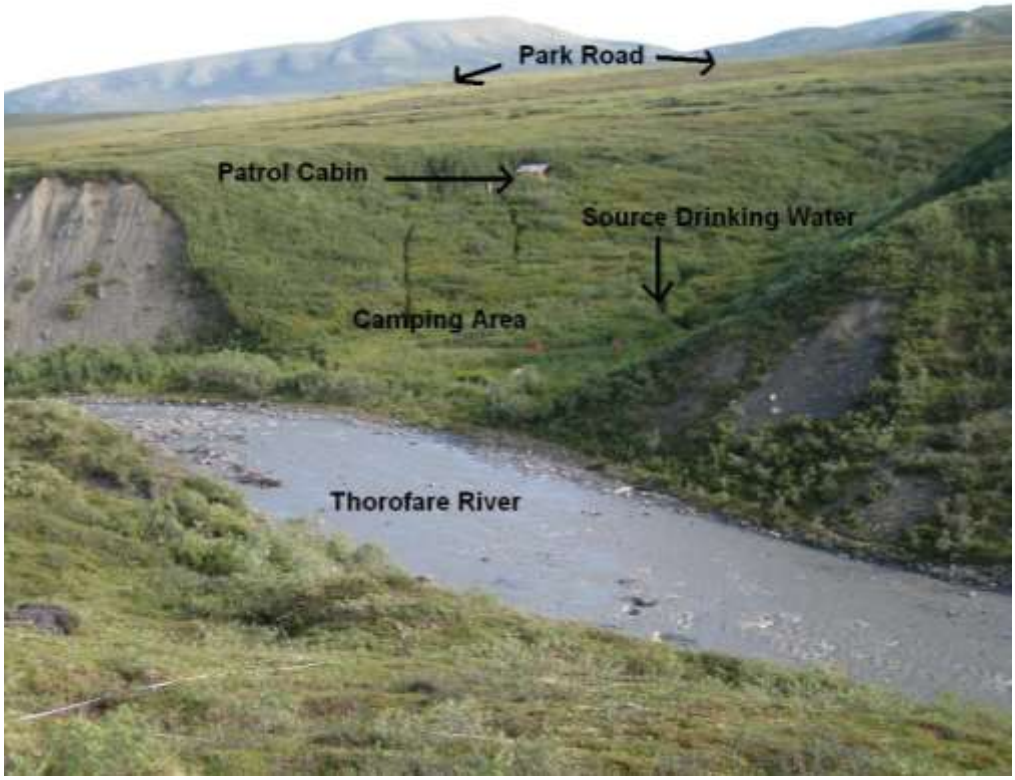


Photo 1. Camp location as viewed from point 7. We were out of view of the main road, and had access to the Thorofare River Patrol Cabin, a fresh water stream, and a crossable stretch of the Thorofare River.

We obtained drinking water from a small fresh water stream flowing in the valley below the cabin. There were large buckets in the cabin that we used for hauling wash/cooking water. For drinking water we used a gravity-fed "base camp" water filter bag that we carried up to the cabin. The stream is fed by a series of small beaver ponds further up the valley. Since there was still water flowing in it at this time of year after the driest July in many years, it is probably safe to assume there will be fresh water available during future visits. Because we were not certain was our water situation would be, we brought a few water jugs and kept them in our vehicle at the gravel pit. During our comings and goings we could refill our personal water bottles from this supply which served as a back up.

While it is best to start the trip with all necessary camping equipment, we were pleased to discover that the cabin was very well equipped. We ended up using the cabin's Coleman cook stove, because it was a big dual burner one. During our stay we also made use of plates, knives, a cutting board, and cookware from the cabin. Once we knew we had these tools available for our use, we could send some of our camping equipment out with the helpers mid-way through the plot and save on the weight the crew would need to carry out on the last day.

We would definitely recommend using this camp location for future visits. It is easily accessible (short hike on a trail) from the Park Road, it is located in the mini grid, it is out of the view of those traveling on the road, it has a cabin available for use, has a source of fresh water, and access to (at least when we were there) a crossable stretch of the Thorofare River.

Photo 2. Organizing equipment at the Thorofare River Patrol Cabin. It was convenient to have a cabin in which to store, organize, and dry out field equipment.

HIKING:

Hiking around the Lower Muldrow mini-grid varies in difficulty by location. North of the Thorofare River the topography is mostly open and gently undulating. There are a few low boggy spots that can be seen in advance and avoided. Vegetation is predominately low brush but in some places it is thick and overhead in height. It is generally quite easy to hike and to navigate in this terrain. On the south side of the river, however, is the Muldrow Glacier beneath a layer of rock, soil, and vegetation. It has much more varied terrain, with many short but steep ups and downs not evident between the contour intervals on the topographic map. This is a landscape that is very actively changing, both due to movement of the glacier, melting and erosional processes. The vegetation alternates between tundra and low brush to thick, high *Salix*, and stands of *Populus balsamifera* saplings. The brush and topography make hiking slower south of the river.

Photo 3. Terrain of the Lower Muldrow mini-grid. The north side of the river (foreground) is generally brushy and flat, in contrast with the more jumbled broken-mound topography on the glacier south of the river (middle ground in front of the high peaks).

Photo 4. Using the Park Road to access plots in the Lower Muldrow Mini-grid. Hiking out to use our vehicle improved efficiency along the road corridor.

We made all of our crossings of the Thorofare River at a point close to our camp. It was about knee deep in the morning, and slightly higher returning at the end of the day after warming increased the rate of melt, adding volume to the stream. As we will describe for

Day 4, we found a nice way to walk from point 10 to point 15, and then we discovered that using the river corridor to return back to camp saved a great deal of time compared with walking over the more varied terrain on the glacier. This route should be considered when accessing points close to the river.

The Lower Muldrow mini-grid has a large number of plots along the Park Road. To improve our efficiency, we hiked out to our parked truck at the gravel pit, and used it to access plots along the road. This worked well for us; both days we worked near the road we completed four plots.

WEATHER AND ENVIRONMENTAL CONDITIONS:

We were very fortunate with the weather while sampling the Lower Muldrow Mini Grid. Most days were clear or partly cloudy and warm, with only a few periods of rain. At several points it was breezy, and the mosquitoes were not bad at all—in some places even absent! Generally, it was cold at night; our last two mornings we woke up to frost on our tents. It was generally true that cold temperatures at night and warm temperatures during the day caused the level of water in the river to be lowest in the morning and highest in the evening. However, we had a notable exception to this pattern. Starting in the very early hours of the morning July 29, a strong, gusty warm wind developed. Jamie and Peter consequently had a very restless night simply due to the noise of their tents rattling and shaking. Carl also woke up in the night to sounds of things blowing over on the front porch of the cabin. At breakfast time, the weather was already very warm, and the water level in the river was higher than it had been the evening before. Thus, the team decided to sample plots in the northern part of the mini-grid and avoid crossing the river until the water level had retreated.

In the previous days, we had heard sounds like deep, rolling thunder coming from the direction of the glacier. We speculated that we were hearing calving and subsidence from the exposed glacial faces along the river. Our suspicions were confirmed the evening of July 29, when, after nearly 24 hours of especially warm breezy weather, the thundering sounds intensified. The sounds seemed to coming from the exposed glacier and lagoon that we encountered on our way to plots 1 and 2 on the first day, a short distance upstream from our camp. Several times we heard loud, thunderous slides and one was so large we could see dust or mist rising up in the air above the suspected location. Shortly after, we observed ice blocks saltating along the river in front of camp, the largest about one to two meters across, sometimes getting caught on debris or gravel bars and stuck.

SAFETY CONSIDERATIONS:

The Lower Muldrow Mini Grid has many of the same safety concerns as other study areas: wildlife, river crossings, and uneven and unstable terrain. We had several wildlife encounters while working in this grid, and potential for encounters is high. The trail connecting the parking area (gravel pit) and the cabin passes by some beaver ponds that were frequented by a mother moose and her two calves. They were often near the trail, and more than once we moved off the trail to give them a wider berth. The stream bottom area where we pitched tents also appeared to be a wildlife corridor, perhaps due to the presence of fresh

water or the topography. We found many tracks of various animals in the wet silt along the riverbank. The first night Jamie and Peter woke up to a large animal moving through the brush near their tents, in the morning there were fresh moose tracks around, even on the path connecting the tent area with the cabin. One night Jamie woke up to sounds of a small animal like a hare or possibly a fox, while Peter again heard a large animal move through. Perhaps in the future a different location could be selected for the tents to solve this problem. At the very least, care should be taken to keep all things with an odor out of the tents, and one person should not be camped in that location alone. On the evening of Aug 2, Peter, Jamie and Carmen observed two separate grizzlies pass through plot 7 on the hill face across the river, opposite camp. This location is about 300 meters from the cabin where we were watching, and much closer to the tents.

Care should also be taken to avoid wildlife while hiking or working on plot. On July 28, while hiking back to camp from plot 5 over the Muldrow Glacier, we stumbled over a very fresh pile of bear scat, full of *Sheperdia canadensis* berries. Shortly after, Peter and Carl spotted the grizzly, moving along eating berries a short distance away. The ups and downs of the topography, as well as the patches of thick brush create many opportunities for bears or people to stumble in to one another, and visibility can be poor. This was the case when we were working in plot 7, within view of our camp. We had just arrived on plot and begun set up when a grizzly came up the hillside towards us from near the river. We shouted, waved, and very quickly grabbed all of our things (which were scattered as is often the case when teams arrive to plot), stuffed them into our packs, and hurried up to a high spot on the hill where we were more visible and where we could see over the edges of the hill to better spot dangers. When the danger of a bear encounter had passed, we resumed the plot, maintaining high alertness. We were subsequently much more careful about leaving items loose around our packs as we worked in our plot and keeping our bear spray accessible even when working on plot. Later in the day, just after we finished plot 6 and were starting to walk away, we spotted fresh grizzly tracks crossing over the tracks we had made in the dried river bar silt on the way to plot. Again, on high alert, we looked around more carefully and spotted a different, darker colored grizzly, coming down the steep, rocky face of the old river bank behind us, and in very close proximity to the plot (Photo 10). Crews working in the Lower Muldrow area in the future should be especially vigilant in looking around and avoiding confrontations with wildlife, particularly in areas of low visibility or where wind or river noise confound or occlude sounds of human voices.

Caution is also required near the river. We succeeded in all of our river crossings using plain common sense, but noted that water levels fluctuated from day to day and hour to hour depending on weather conditions. Large ice chunks could pose a threat if they are present when crossing. Warm weather also brought calving, subsidence, and landslides along exposed areas of the glacier, underscoring the instability and rapid deformation occurring in what might otherwise appear to be solid ground. Care should be taken approaching precipices that could give way under foot, especially where the glacier meets the river.

Close proximity to the Park Road made this grid seem less remote than other mini-grids. Radio communication was always possible, sat phone coverage normal, and often traffic on the road was within view.

PHENOLOGY OBSERVATIONS:
Shrubs were the dominate vegetation in the Lower Muldrow mini-grid. Several different species of willow including *Salix richardsonii, Salix alaxensis,* and *Salix pulchre* were regularly identified, and several others were collected. *Shepherdia canadensis* was particularly abundant on the glacier, which caused some vexation assigning Viereck codes, since the key does not include *Shepherdia* as a dominant or indicating species. *Betula nana* was abundant, particularly in the northern part of the grid.

We sampled the Lower Muldrow mini-grid late in the season, so most flowers were gone, and the majority of species were in fruit. This was delightedly so for *Vaccinium uliginosum*, and *Empetrum nigrum,* but also many of the grasses and sedges such as *Trisetum spicatum, Festuca richardsonii,* and *Carex bigelowii.* Some flowers could still be found, however, particularly the overgrown, shaded species: *Cornus canadensis, Linnaea borealis, and Stellaria longipes.*

Plots in the Lower Muldrow mini-grid averaged 32 vascular plant species, with 53 being the most species for an individual plot.

GENERAL NOTES ON PLOT-WORK AND PLOT OBSERVATIONS:

The division of duties changed throughout our work on the Lower Muldrow mini-grid. Days 1-4, the team was Peter, Carl, and Jamie. Carl made the vascular plant collections and grid point data sheets, Jamie took photos, and Jamie and Carl worked together for the transects and quadrats. On day five, Carmen joined the group partway through the day, and took responsibility for the photos. On day six, Carl left the group and Jamie took lead responsibilities for vascular plant identification and collection.

Work on this mini-grid went quickly, in part because we were able to camp within the grid, the weather was generally pleasant, and the terrain and vegetation sampling was not difficult. There were no trees to core in this mini-grid, and saplings occurred only at a few plots. Additionally, it was at the end of the season, so everyone was more confident in their tasks and the group, though it changed, was familiar working together. There was one inaccessible plot, number 15, located in the Thorofare River. **We were able to sample the 24 remaining plots in just seven days**; there were four days in which we sampled four plots. As mentioned before, two of the four plot days involved working near the road and using a vehicle to reduce the hiking time. Future work in the Lower Muldrow mini-grid should involve contingency plans for leaving the field earlier than the normal 10 days, although under different conditions (inclement weather, hordes of mosquitoes, inexperienced crew) it may take longer for another crew to finish.

Table 1. Collection series for the Lower Muldrow mini-grid.

Collector	Identifier	Series
Roland	Vascular plants	CR09-076—CR09-108
Martin	Vascular plants	JM09-130—JM09-146
Nelson	Nonvascular collections	PRN 09-277 -398

ACTIVITES:

Monday, July 27

Plots 1 and 2.

Today we loaded equipment into two pickup trucks and drove to a gravel pit approximately 70 miles in on the Park Road. Carl, Peter, and Jamie with the assistance of helpers Carmen, Wendy and Eleanor loaded all of the field equipment, camping and personal gear and carried it in to the Thorofare River Patrol Cabin. The hike was just over 1 km, and along a trail, so it went quickly even with our heavy loads. After the helpers left, (taking one vehicle and leaving one at the gravel pit) Peter and Jamie set up their tents. The first attempt was to use the flat open spot just above the cabin, but this place was in clear view of passing traffic on the Park Road. Alternatively, Peter and Jamie pitched tents in a flat area close to the river. Carl stayed in the cabin.

After lunch, we made our first crossing of the Thorofare River at a spot close to our camp. We tried walking to plot 1 first by following along the southern river bank but reached a deep proglacial lake with icebergs below a steep headwall of exposed ice. After consulting the maps and satellite images and looking around, we realized that the river had made a dramatic change of course since the most recent IKONOS image, dated 2006. (For photo and description of the new river course, read the note in Conclusions and Future Considerations.) We climbed up and around this headwall to get to plot 2. Plot 2 was a mix of moss and *Dryas* with a closed *Salix* and *Sheperdia canadensis* shrub and a stand of *Populus balsamifera* saplings. After finishing plot 2, we tried again to reach plot 1, which was located on the vegetated snout of the glacier, above the river. It was slower moving around plot 1 because of the steepness and the thicker *Salix* brush.

We returned to camp by hiking downhill to the river, finding a wide spot to cross, and then following a dry old river channel most of the way back to camp. The weather today was warm at times (80° F when Peter did soils in the afternoon) but was pleasantly breezy and partly cloudy which made most of the day comfortable and reduced the bugs.

Tuesday, July 28

Plots 3, 4, and 5.

Crossing the river was no problem near the cabin. Plot 3 was *Shepherdia canadensis* and *Salix* scrub with a ground cover of *Dryas integrifolia* and nice views of the mountains.

Walking between plots was better than most grids, but still more rigorous than maps and aerial photographs would suggest. There were constant “breaks” or “cracks” in the topography that abruptly drop vertically for several meters and then straight back up again. In a few of these cracks, it was possible to stand in the bottom with outstretched arms touching the opposing vertical faces. These cracks were nearly always full of *Salix* shrubs. The constant up and down and push through *Salix* thickets were the greatest factor slowing progress.

Plot 4 was on a steep hill of unconsolidated glacial till above a little kettle pond (see Photo 5). The last 1.5 m or so of the N transect actually went into the lake, so Peter did not collect a soil samples from that location. The water was perfectly clear and nice to look at. This plot went slower because of the dense brush. Carl saw a caribou from plot 4, looking north beyond the lake. Jamie found a moonwort (*Botrichium*).

Photo 5. Overview of plot 4. Peter is at the E edge of the plot, and the N transect ends in the kettle pond below. This plot took a little longer due to the thick brush.

Plot 5 went a little more quickly. It was located on a dry knob and contained a mix of poplar saplings, *Shepherdia canadensis* and *Salix* open scrub, and *Dryas* tundra with lots of *Stereocaulon* lichen.

The weather was warm with intermittent breezes and clouds. While we were at Plot 5, we watched a very distinct "wall" of smoky air move in, felt a few raindrops and heard sounds that could have been thunder or distant icefall. As we were hiking back to camp, we found some very fresh bear scat not far from plot 5. The bear had been eating berries of *Sheperdia canadensis.* We tried to be cautious in our route selection but were always finding ourselves in shrubby cracks where visibility was limited. Peter and Carl then spotted a grizzly making its way out of our area, eating berries as it went.

Wednesday, July 29

Plots 22, 23, 24, and 25.

The weather was cool and windy and mostly cloudy. We had planned to cross the river again but it was higher this morning than even last night, so we decided to go a different direction

and wait to see if the water would recede. (Details of this weather episode were mentioned in the weather section, previously.) Today's plots were along the Park Road. We hiked out to the vehicle we had parked at the gravel pit and drove to our plots. This was complicated by the fact that the very same short stretch of road was being grated, and chemically treated with calcium chloride. Between the tour buses and the construction vehicles there was unusually high road activity and we had lots of people watching us work.

Photo 6. Overview of plot 25 looking SW. Gently undulating terrain with low scrub was typical for plots along the Park Road.

Plot 25 was on a slight knoll above a wetland area. It was rather uniformly low birch/willow/blueberry scrub. Plot 24 was just 80 meters from the busy road. It was mostly low birch/willow scrub with considerable moss and *Calamagrostis canadensis.* Around lunchtime we got some nice views of Denali and surrounding mountains. Plot 23 was also close to the road, but clearly there was a prevailing wind direction, because the vegetation on the north side of the road is coated in fugitive road dust. Plot 23 was a meadow scrub with slight depressions.

The fourth plot of the day, 22, was interesting in that there were lots of high earthen hummocks with channels or spaces in between them (up to 1 meter or so tall). When stabbed with a soil probe, they did not appear to contain rocks or ice. In and around these hummocks were patches of *Salix pulchre* with lush tundra/meadow species in between. Peter reported slightly warmer soil temps at this plot compared to the previous three plots today.

Hiking to camp from the gravel pit, Jamie saw a wood frog. It was light to medium brown with black leopard like spots on its sides. It was astonishingly large for a wood frog, maybe 8 or 9 cm from head to rear. It seemed especially fat, even when stretched out hopping. Based on the size it was probably female, but after a day of work, Jamie was not fast enough to catch it for a better look before it hopped away.

This evening after dinner we heard the thunder sounds, saw spray and icebergs as described in weather section.

Thursday, July 30

Plots 8, 9, 10, and 15.

Today weather started cool with thick low clouds. We crossed the river and hiked to point 8, which was scattered willow and *Shepherdia* in a matrix of *Dryas*/forb/moss and *Salix reticulata* tundra. We finished quickly and went to 9. Plot 9 was located in the middle of a deep, steep depression with Poplars and willow scrub. This plot took a little longer to set up and move through. The perimeter of the plot was on hilltop with tundra that was easier to move through, the center of the plot was in the depression with shrubs everywhere, so it was more expeditious to walk around the plot perimeter than through the center. We took lunch in the middle of working on plot 9. During lunch, it really started to feel cold. We put on all of our available clothing, and looked over the landscape with low clouds everywhere. Then in the next hour or so that it took for us to do the quadrats, the weather changed. It got much warmer (a change of about 30° F), the clouds lifted, and we were left with a mix of sun and smoke for the rest of the day.

Plot 10 was a challenge. It was located on a steep subsiding rock face above a small kettle pond surrounded by thick brush. The subsiding rock face was part of a larger sinkhole appearing on the glacier, and was actively eroding (photo 7). The steepness, brushiness and lack of firm footing caused all of us to slide or tumble at least once. It took time to do this plot. After finishing 10, we walked toward 15 and the river, staying low and walking along a series of dried kettle ponds. There was much easier walking this way and this route should

Photo 7. Overview of plot 10, located on subsiding face of giant sinkhole in the glacier surface.

Photo 8. Peter locating center of plot 15 in Thorofare River.

Be used in the future. Plot 15 was in the Thorofare River. Peter waded out into the river with the Trimble, and Carl took photos of where the plot should be (photo 8). Afterwards, we walked back along the river. This was much easier walking than the ups and downs through thick brush found on the glacier. Water was higher but still fordable at the crossing near camp.

Friday, July 31

Plots 21, 17, 16, and 12.

We expected Carmen to join us around lunchtime, so we did some plots near the Park Road today so she could find us more easily. Another consideration for us was that Carl planned to leave and take the vehicle the next day, so this was our last chance to use it to reach plots. Our first plot, 21, went rather quickly. It was lower diversity ericaceous/birch scrub with patches of *Salix pulchre.* After some deliberation, Carl assigned it one Viereck class. Although there are distinct patches, on a larger scale this mosaic represents a single type. This discussion, as to whether one or more Viereck classes were most appropriate, was ongoing throughout the grid. Even though it rained a little last night, this morning was sunny and clear for photography.

Our second plot, 17 was also close to the road. We made good progress, and as we broke for lunch, Carl commented, "This is optimal". Indeed, there were clear skies, sunshine, beautiful view, nice breeze, no bugs, ripe blueberries, and even soft tundra moss and shrubs to lie back in and watch the clouds go past. As we returned to work finishing the second plot after lunch, Carmen joined us. We did plots 16 and 12 as a four person crew. Plot 16 was near to the cabin. It was in high (2m) willow shrubs with very high diversity (53 species) for vascular plants. While we were working on the last plot, the weather became chilly and started to rain. Tramping back to camp, everyone got wet. We had a nice social dinner with Carmen cooking and everyone sitting on the cabin porch out of the weather.

Saturday, August 1

Plots 18, 19, 20, and 11.

This morning Carl drove us near to our first plot (20) wished us well, and left.

Plots 20, 19, and 18 were located in the broad, mostly flat area between the Thorofare River and the Park Road. They consisted of mainly low scrub, and the hiking and movements on plot were pretty easy. Then we decided to do plot 11, near our campsite. It was on the hillside opposite the hiking trail we use coming and going from the gravel pit. While there, we saw a moose with two calves and beavers in the ponds below us. The beavers made warning slaps on the water as we crossed the creek on our way to plot. Plot 11 was a bit higher diversity with some alpine surprises like *Hierchloë alpina* and *Cassiope tetragona*. Although it was cloudy and cool this morning, it cleared in the afternoon. We had a short squall with sleet and hail at the third plot, but beautiful evening light for the fourth.

Sunday, August 2

Plots 7, 13, 14, and 6.

The weather today was sunny and warm all day, the previous night was clear and cold; this morning we woke with frost on our tents. In anticipation of a warm day, we started by completing the last remaining plot south of the river to avoid crossing the river later in the day. Plot 7 was located on a hill face across the river from our camp. Shortly after unloading our packs and starting to set up the plot, we had a grizzly come within very close distance of our plot as described previously in the safety considerations paragraphs. We were on high alert for bears the rest of the day.

To get to plots 13 and 14, we crossed the Thorofare near our camp, and then walked along the river bank. It seemed much easier hiking this way, and was also a nice change from the endless shrub tundra of the previous days. Plot 13 was on a slight knob with lots of waist-to-shoulder high willows. However, there were quite a few species to be found there, including juniper. Plot 14 was located on the upper edge of a gully containing a small, almost dry stream flowing down to the Thorofare River. Part of the plot was in the gully and part was out. Right through the middle of the plot ran a well-worn game trail. In fact, the game trail went right through Quadrat C. In spite of this disturbance, or perhaps because of it, there was very high diversity in this plot. For this reason, and also because of the brushiness, this plot took more time.

When we finished with plot 14, we walked down the gulley to the river, and walked to plot 6 along the river. Plot 6 was located on a dried-up river channel below a loose rocky slope. It was challenging to assign a Viereck class to this plot because the cover of a few *Salix* and *Populus balsamifera* saplings was too great for the plot to be called barren, and yet not enough to qualify as shrub, but it was inappropriate to call the vegetation herbaceous since there were really just a few individual graminoids and patches of *Dryas drummondii*. As we were leaving the plot we found fresh grizzly tracks over the top of the tracks we made going to plot. We then located the grizzly—approaching plot 6 from the steep rocky slope above, as described previously in the safety section. Carmen, who was still taking overview shots of the plot, snapped a quick photo of the bear before joining Jamie and Peter for a brisk walk to camp once the bear was on his way (Photo 10).

In the evening, we observed two separate grizzlies climb the hill face across the river from camp, passing through or very near to plot 7. We left a note in the Thorofare River Patrol Cabin guestbook to document our use of the facility.

Photo 9. Jamie standing on game trail passing through plot 14.

Photo 10. Grizzly near plot 6.

Monday, August 3

Today was beautiful weather, frosty in the morning and then sunny and warm. Skies were clear in morning with smoke accumulating in the afternoon. We cleaned the cabin to leave it tidy. We packed all of our equipment and gear and carried it out to the gravel pit. While we were sorting stuff and loading into the van at gravel pit, a ranger drove by and stopped. She had seen our tents day before, and wondered why we didn't have permits. A simple explanation of who we are and what we were doing cleared up the confusion. We enjoyed terrific views of Denali today.

CONCLUSION AND FUTURE CONSIDERATIONS

The Lower Muldrow Glacier Mini-grid offers the opportunity to study vegetation in a landscape riven by geologic disturbance over small spatial and temporal scales. Freezing and thawing action of permafrost in the northern part of the grid causes the emergence and disappearance of ponds and wetlands, leaving a legacy in the observed vegetation and micro topography. Heaving and subsidence of the Muldrow Glacier impacts the communities growing on the glacier surface, by displacing or destroying some individuals while creating a new opportunity for others. Even more radically, melting and break up of the glacier is actively changing the volumes of water and course of the Thorofare River. In the time since the IKONOS image was taken (2006), the river changed its course through the mini-grid. Instead of flowing from near point 6 to near point 7, it now flows from near point 1 to near point 7. Near point 6 is a broad, barren former river channel that is only starting to be colonized by vascular plants (Photo 11). The thundering sounds, clouds of dust and floating icebergs we observed during our visit came from an exposed ice face at the glacial snout that is actively melting and breaking. This is a reminder of how dynamic and disturbed the ecological communities of the Lower Muldrow mini-grid have been, are now, and likely will continue to be.

Take home messages:

- Future crews should strongly consider using the Thorofare River Patrol Cabin as a base of operations
- Future crews should be on high alert to avoid confrontations with wildlife, especially moose and grizzly bears, in the area of the Lower Muldrow Glacier mini-grid.
- Future crews should have contingency plans in place in the event of finishing earlier than the typical 10 days, such as keeping a vehicle parked and waiting at the gravel pit. It is also useful to have a vehicle available to reach plots along the road corridor and store a backup supply of water.
- Future crews should anticipate and be watchful for many rapid changes, both subtle and dramatic, to the landscape and biotic communities of the Lower Muldrow Mini-grid.

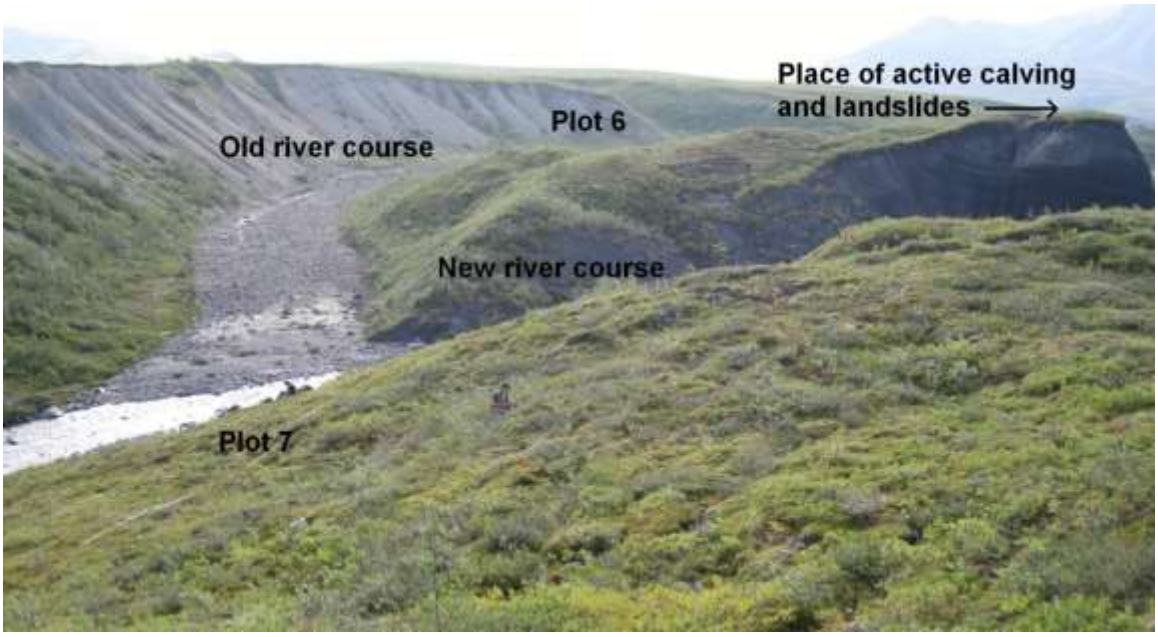
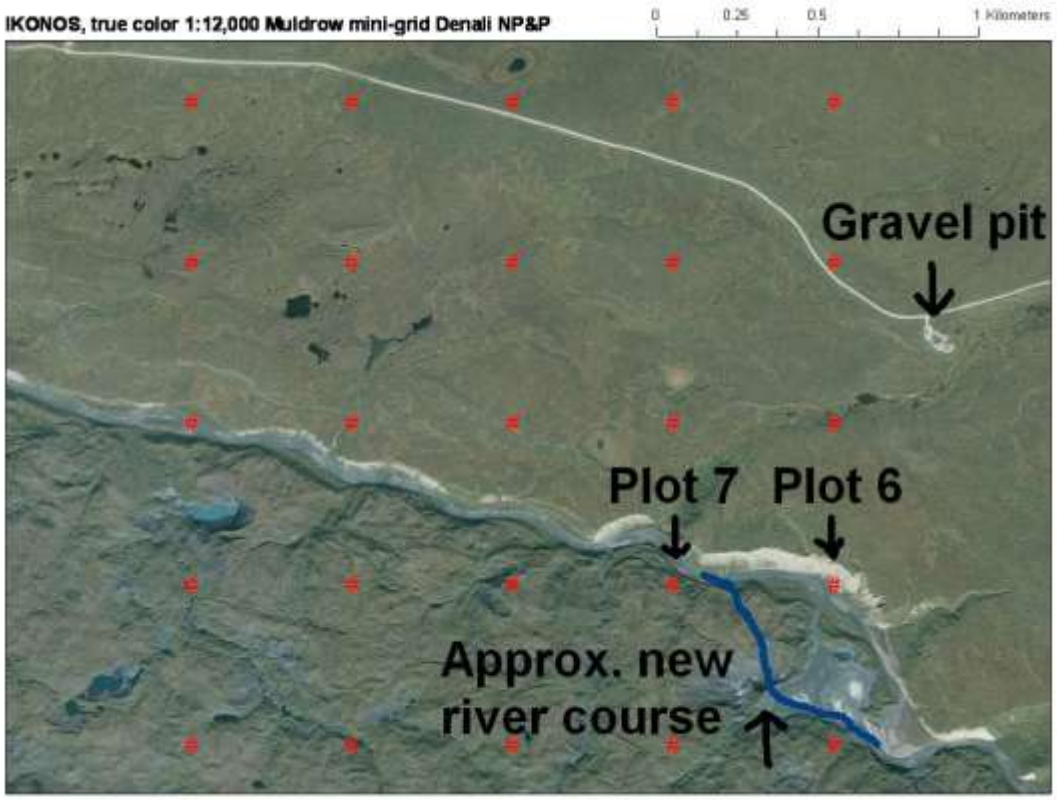
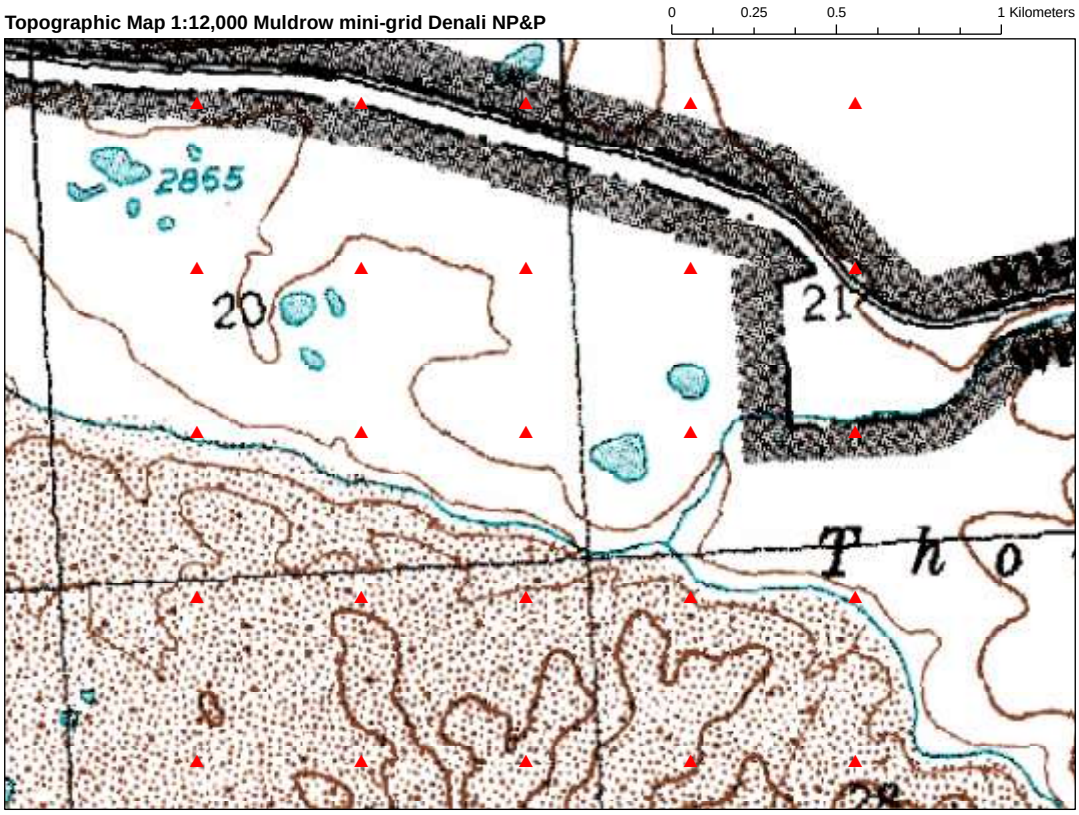


Photo 11. Recent changes to the course of the Thorofare River through the Lower Muldrow Mini-grid. The old river channel offers new terrain to colonizing species; the new channel is rapidly melting a face of exposed glacier.



Map 1. IKONOS image of Lower Muldrow Glacier Mini-grid from 2006. The course of the Thorofare River has changed in the three years since the image was captured. Also indicated is the location of the gravel pit where we parked to hike to the Thorofare Patrol Cabin.



Map 2. Topographic map of the Lower Muldrow Glacier Mini-grid

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